

What is claimed is:

1. A liquid distillation system comprising:
  - a) an input for receiving untreated liquid;
  - 5 b) a vaporizer coupled to the input for transforming the liquid to vapor;
  - c) a head chamber for collecting vapor from the vaporizer;
  - d) a liquid ring pump comprising:
    - i. an internal drive shaft;
    - ii. an eccentric rotor with a rotatable housing;
  - 10 e) an electric motor having a motor rotor and motor magnets to power the drive shaft wherein the motor rotor and magnets are hermetically sealed within a liquid fluid pressure boundary of the liquid ring pump; and
  - f) a condenser in communication with the vapor pump for transforming compressed vapor into a distilled liquid product.
- 15 2. The liquid distillation system as in claim 1 wherein the rotor further comprises a multiplicity of vanes separated by chambers, each chamber having an intake and an exit.
- 20 3. A liquid distillation system according to claim 1 wherein the input is coupled to at least one heat source.
4. A liquid distillation system according to claim 1 further comprising a sump wherein liquid from the vaporizer may be preheated at start-up.
- 25 5. A liquid distillation system according to claim 4 wherein the vaporizer has a plurality of parallel tubes, each tube having a first open end in communication with the sump and a second open end in communication with the head chamber and wherein each of the plurality of parallel tubes is sealed at the first end and second end by an elastomer tube seal.
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6. A liquid distillation system according to claim 5 further comprising a regulator for maintaining a liquid level sufficient to permit both purification of liquid from the vaporizer tubes and damping of local turbulence.

5 7. A liquid distillation system according to claim 1, the system further comprising a regulator for maintaining and controlling pressure in the condenser.

8. A liquid distillation system according to claim 1 further comprising an output for collection of condensed liquid product and further in connection with the input for  
10 recycling the blowdown stream.

9. A liquid distillation system according to claim 1 further comprising a pre-treatment assembly coupled to the intake.

15 10. A liquid distillation system according to claim 1, the system further comprising a heating unit for heating intake liquid upon startup.

11. A liquid distillation system according to claim 1 further comprising a heat exchanger for receiving liquid from the input such that heat from at least one source is  
20 exchanged with the input liquid.

12. A liquid distillation system according to claim 11 wherein the at least one heat source includes the product stream, the blowdown stream, system waste heat, vapor pump waste heat, motor waste heat, engine exhaust heat from a power source, and an external heat  
25 source.

13. A liquid distillation system according to claim 1 wherein the electric motor is a permanent magnet brushless motor.

30 14. A liquid distillation system according to claim 1 further comprising a power source coupled to the system wherein the power source is a clean-burning generator.

15. A liquid distillation according to claim 1, further comprising a siphon pump to pump liquid into the vapor pump from a reservoir.

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- a. vaporizing untreated liquid to form a vapor in such a way as to fill a head chamber;
  - b. compressing the vapor by rotating the vapor in a liquid ring pump using an internal drive shaft and eccentric rotor with a rotatable housing using an  
10           electric motor having motor rotor and motor magnets hermetically sealed within a liquid pressure boundary of the liquid ring pump; and
  - c. condensing the compressed vapor into a distilled liquid product.

17. A method of distilling a liquid according to claim 16, further comprising pre-  
15   treating the untreated liquid using at least one pre-treatment method including UV light exposure, treatment with polyphosphates, polyacetates, polyaspartates, organic acids, acidification, and exposure to an oscillating electric or magnetic field.

18. A method of distilling a liquid according to claim 16, further comprising  
20   regulating the internal pressure of the condenser.

19. A method of distilling a liquid according to claim 18, further comprising maintaining a super-atmospheric pressure.

25           20. A method of distilling a liquid according to claim 16, further comprising maintaining a liquid level in the head chamber sufficient to permit both purification of liquid from the vaporizer tubes and damping of local turbulence.

21. A method of distilling a liquid according to claim 20 further comprising  
30   diverting a blowdown stream from the head chamber for maintaining a constant liquid level in the head chamber.

22. A method of distilling a liquid according to claim 16, further comprising coupling a clean-burning generator to the system wherein the clean-burning generator produces mainly CO<sub>2</sub>, N<sub>2</sub> and water as the exhaust.

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23. A method for of distilling a liquid according to claim 22, further comprising directing the exhaust to the intake liquid for pre-treatment acidification and heating of the intake liquid.

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24. A method of distilling a liquid according to claim 16, further comprising using an eccentric rotor having a multiplicity of vanes separated by chambers, each chamber having an intake hole and an exit hole.

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25. A method of distilling a liquid according to claim 16, further comprising eliminating entrained liquid droplets from the vapor in the vapor pump

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26. A method of distilling a liquid according to claim 16, further comprising using a vaporizer connected to a sump, said vaporizer having a plurality of parallel tubes, each tube having a first end in communication with the sump and a second end in communication with the head chamber wherein each of the plurality of tubes is sealed at the first end and second end by an elastomer tube seal.

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27. A method of distilling a liquid according to claim 16, further comprising using a heat exchanger for receiving liquid from the input wherein heat from at least one source is exchanged with the input liquid.

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28. A method of distilling a liquid according to claim 27, further comprising exchanging heat with the liquid in the heat exchanger from the at least one source including the product stream, the blowdown stream, system waste heat, vapor pump waste heat, exhaust heat, and an external heat source.

29. A method of distilling a liquid according to claim 16, further comprising priming the system before start-up with a minimal amount of liquid.

5 30. A method of distilling a liquid according to claim 16, wherein post-treating includes at using at least one of UV light exposure and other sterilization methods suitable for maintaining potability.

31. A method of distilling a liquid according to claim 16, wherein post-treating includes adding an additive to the liquid.

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32. A method of distilling a liquid according to claim 31, wherein the additive is at least one of a sugar-based additive, an acid, and a mineral.

15 33. A method of distilling a liquid according to claim 31, wherein the additive is at least one of a nutrient, a vitamin, a stabilized protein, and a fat.

34. A method of distilling a liquid according to claim 31, wherein post treating includes measuring a physical property of the liquid.

20 35. A method of distilling a liquid according to claim 34, wherein measuring a physical property of the liquid includes measuring at least one of pH, conductivity, hardness, and a concentration of a component in the liquid.

25 36. A method of distilling a liquid according to claim 16, further comprising: measuring the TDS in a blowdown liquid from the vaporized untreated liquid; and adjusting a source feed rate of untreated liquid if the TDS is above a prescribed level.

37. A liquid distillation system according to claim 1, wherein the condenser and the vaporizer are in thermal contact.

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38. A liquid distillation system according to claim 37, wherein the condenser includes a surface with a hydrophobic coating, the surface configured to contact compressed vapor and liquid.

5 39. A liquid distillation system according to claim 1, wherein the vaporizer has a plurality of parallel core layers with rib sections that create channels for directing steam and condensed liquid flow.

10 40. A liquid distillation system according to claim 39, wherein alternating parallel core layers comprise an evaporator channel and a condenser channel such that evaporation and condensation are separated.

15 41. A liquid distillation system according to claim 40, further comprising a fluid distribution manifold having flow regulation, mist removal, and pressure regulation in a single unit.

20 42. A liquid distillation system according to claim 41, wherein core plates and manifolding may be made of, for example, plastic, metal, or ceramic plates, or any other non-corrosive material capable of withstanding high temperature and pressure.

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